

The Cost Estimating Process

Module 1

**ESC Cost Core Training
Developed By**

**USAF ESC/FMC
Hanscom AFB, MA
Version 2 (Draft)
March 2000 (by ESC/FMC)**

**Revised
June 1993 (by Tecolote Research, Inc.)
August 1997 (by Tecolote Research, Inc.)**

**Apr 91
Version 1 (by ESC/FMC)**

The Cost Estimating Process - Part 1

7 Steps of the Cost Estimating Process	6
• Step 1: Defining & Planning	7
– Know the Purpose, Scope & Time Constraints	8
– Review Program Documentation	9
– Establish Multi-Disciplined Team	10
– Program Definition	12
– Establish a Work Breakdown Structure (WBS)	14
– Summary - Step 1 Define & Plan	18
• Step 2: Specify Estimating Methodology	19
• 1. Analogy	20
• 2. Catalog Prices/Vendor Quotes	22
• 3. Extrapolation From Actuals	24
• 4. Factors	25

• 5. Grassroots	26
• 6. Manloading	27
• 7. Parametrics	28
– Implementing Methodologies	29
– Know Strengths & Weaknesses for Each Technique	30
– Develop Estimates More Than One Way	31
– Use Sound Logic and Supporting Methodology	32
– Data Collection and Evaluation	33
– Risk Assessment	35
• Incorporate Dollars to Offset Risk	36
• Conduct Cost Sensitivity Studies	37
• Obtain Range vs. Point Estimates from Functional Specialists	38
• Emphasis on Realism	40

- Summary - Step 2 Estimating Methodology	41
- Step 3: Calculate the Cost Estimate	42
• Step 4: Time Phase the Cost Estimate	43
- Time Phasing	44
- Engineering, Manufacturing & Development	45
- Procurement	46
- Operations & Support (O&S)	47
- Consistency With Acquisition Strategy	48
• Step 5: Inflate to Then Year Dollars	49
• Step 6: Document the Cost Estimate	50
- High Quality Cost-Estimate Documentation	51
• Step 7: Complete Final Reviews	52
• Summary of the Estimate Process	54

Process: a series of
actions or steps producing
an end result

Our goal in the Estimating Process
is to produce a solid, healthy cost
estimate.

7 Steps of the Cost Estimating Process

- ① Define and Plan
- ② Specify Estimating Methodology
- ③ Calculate -- Including What-ifs & Alternatives
- ④ Time Phase in Base Year Dollars
- ⑤ Inflate to Then Year Dollars
- ⑥ Wrap Up Documentation
- ⑦ Complete Final Reviews

Step 1: Defining & Planning

- Know the Purpose, Scope and Time Constraints
- Review Program Documentation
- Establish Multi-Disciplined Team
- Program Definition
- Establish Work Breakdown Structure (WBS)

Know the Purpose, Scope & Time Constraints

- What is the estimate going to be used for?
- What is the budget purpose?
- Where is the estimate going?
- Who is going to use it?
- What decisions are going to be based on it?
- How soon is the estimate due?

Review Program Documentation

- Program Management Directive (PMD)
- System description information
- Program schedule
- Acquisition strategy

Establish Multi-Disciplined Team

- Hardware engineer(s)
- Software engineer(s)
- Someone familiar with the test program
- Budget person
- Possibly someone from procurement

Scenarios

- #1 - Estimators ask the Program Office if they have definition for the program. The Program Office says “no” and the estimators go home.
- #2 - Estimators ask the Program Office if they have definition for the program. The Program Office says “yes, it’s all done.”

Program Definition

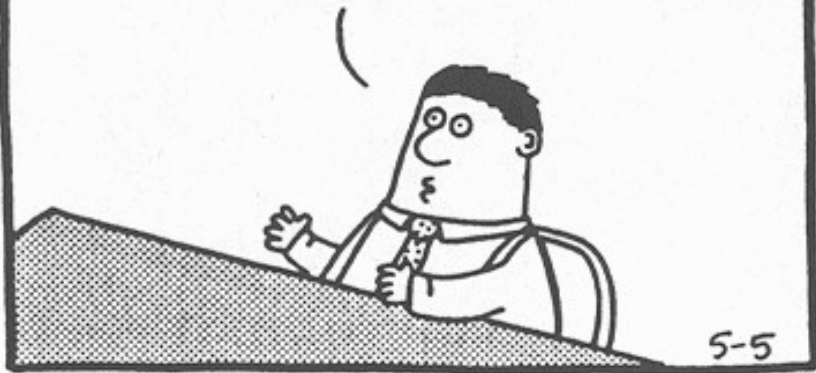
- A general system description is not enough information to accomplish a cost estimate.
- A Program Definition of sufficient detail is needed to derive a cost estimate.
- Specific information for each hardware and software item in the Program is needed before beginning a cost estimate.

WE DON'T KNOW WHAT
THE PRODUCT SHOULD
DO OR WHO WOULD
USE IT.



S. Adams

BUT IF YOU COULD
TELL US WHAT IT
COSTS TO BUILD IT,
WE'LL FIGURE OUT
THE REST LATER.



5-5

© 1994 United Feature Syndicate, Inc.

Establish a Work Breakdown Structure (WBS)

- The WBS is a specific breakdown of tasks required to develop and produce the weapon system program.
- MIL-HDBK-881 provides guidance on the preparation and use of Work Breakdown Structures:
www.acq.osd.mil/pm/newpolicy/wbs/mil_hdbk_881/mil_hdbk_881.htm

WBS Example page 1

Level	1	2	3	4
	System (Contract)			
		Prime Mission Product		
			Radar	
				Hardware Components
				Software Components
		System Engineering/Program Management		
		System Test & Evaluation		
		Training		
		Initial Spares		
		Common Support Equipment		

WBS Example page 2

Level 1	2	3	4
	Peculiar Support Equipment Data		
	Operational Site Activation		
	Risk/Engineering Change Orders (ECOs)		
	Non-Contract		
	Government Furnished Equipment (GFE)		
	Government Test Agency Support		
	System Program Office (SPO) Costs		

The WBS & Communication

- Contract and Procurement people refer to Contract Line Items (CLINS) that identify the various tasks in the contract
- Program Engineers use Requirements Documents and Statement of Objectives (SOO) to identify requirements and specifications

Summary - Step 1 Define & Plan

- Know the purpose, scope and time constraints of the estimate
- Obtain the program definition
- Review available documentation
- Establish a multi-discipline team
- Develop a WBS as a standard communication tool

Step 2: Specify Estimating Methodology

7 Estimating Methodologies

- 1 - Analogy
- 2 - Catalog Prices/Vendor Quotes
- 3 - Extrapolation from Actuals
- 4 - Factors
- 5 - Grassroots
- 6 - Manloading
- 7 - Parametrics

1. Analogy

- An analogy is a comparison based on similarities.
- Your cost can be developed by comparing your program to the cost of a similar program.

Analogy Assumptions

...are the *complexity factors* or ratios that relate one piece of a program to a similar piece.

Example:

B

Program A

Program

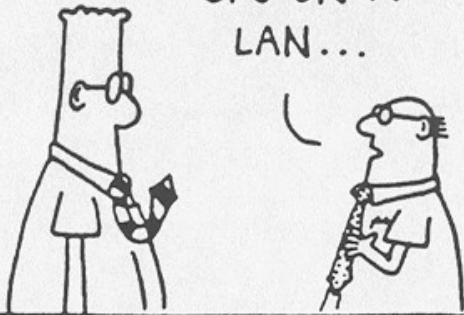
radio

radio

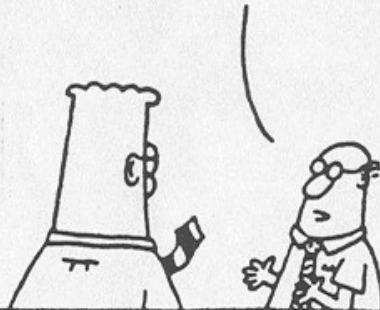
2. Catalog Prices/Vendor Quotes

- This methodology can be used whenever you are dealing with Commercial Off-the-Shelf (COTS) hardware or software.
- COTS means that a company has already developed and made the item so you can now buy it off the shelf.

... SO, EITHER AN
IBM 586 WITH
10 MEG RAM OR
MAYBE A SPARC
CPU ON A
LAN...



... BUT WITH AI AND
AVR COMBINED WITH
BISDN, WELL, IT'S
VERY G.



G?



GOOD.



© 1993 United Feature Syndicate, Inc.

3. Extrapolation From Actuals

... is based on actual costs to date.

- If an effort has incurred a sufficient percentage of total anticipated costs, you can extrapolate or predict the total costs at completion.
- Divide the actual costs to date by the percentage complete.

4. Factors

- The cost of an item is calculated as a percentage of something else.

Example: In Logistics, Initial Spares might be estimated as 20% of the initial cost of buying the hardware.

5. Grassroots

- This involves breaking down all of the tasks in a weapon system program into labor and material costs.
- It is very time consuming.
- Contractors are more likely to use this approach than Government estimators.

6. Manloading

. . . is the use of experts to determine how long it will take a number of people to complete a project.

7. Parametrics

- To help predict cost, develop cause-effect relationships or models based on a cost-driving *parameter*.
- A cost estimating relationship (CER) is an equation. Using statistics and math (e.g. regression analysis) draw a mathematical relationship between variables.
- If the relationship is described by more than one equation, it is a *cost model*.

Implementing Methodologies

To implement any of these 7 methodologies you need to know:

- what type of information is required
- reliable sources of that information
- when to use a particular methodology

Know Strengths & Weaknesses for Each Technique

- There are many driving factors in selecting a methodology to use.
- Frequent pitfalls for each methodology must be known if they are to be avoided.

Develop Estimates More Than One Way

- Why? You need a second or alternative methodology to confirm your primary one.
- It is a confidence check for your estimate - a confirmation.

Use Sound Logic and Supporting Methodology

- Establish confidence
- Confirm and substantiate

Data Collection and Evaluation

- Integrated cost, schedule and technical information
- Know standard sources
- Search out new sources
- Capture historical data

Data Collection and Evaluation

- Integrated cost, schedule and technical information
- Know standard sources
- Search out new sources
- Capture historical data

Risk Assessment

- ① Incorporate dollars to offset risk
- ② Conduct cost sensitivity studies
- ③ Range Estimates vs. Point Estimates
- ④ Emphasis on realism

Incorporate Dollars to Offset Risk

- Incorporate the appropriate dollars to offset the most likely risk.
- Address risk in the following areas
 - Technical Parameters/Baseline
 - Schedule
 - Estimating Methodology
 - Estimate Assumption

Conduct Cost Sensitivity Studies

When you have identified the risk variables in your estimate, assess what happens if they increase or decrease.

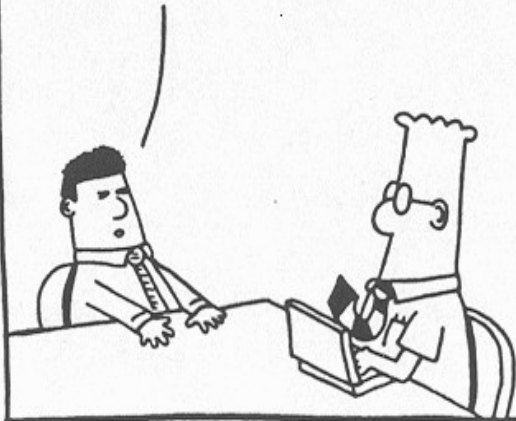
Models/equations should provide this type of information. Plug in a new factor and see what happens to the other numbers.

Assessing these model results is a sensitivity study - evaluating the model results for different input parameters.

Obtain Range vs. Point Estimates from Functional Specialists

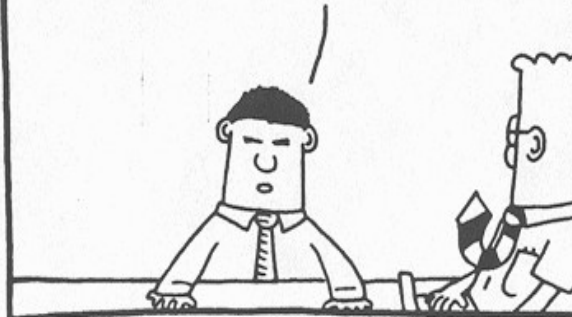
- Point estimates are difficult for engineers to provide.
- Point estimates do not enable the estimator to understand the degree of certainty or uncertainty in the engineer's mind.
- Give the engineers the opportunity to provide a most-likely range estimate.

THE PROJECT REQUIREMENTS ARE FORMING IN MY MIND.



S. ADAMS

NOW THEY'RE CHANGING...
CHANGING... CHANGING...
CHANGING... OKAY. NO,
WAIT... CHANGING...
CHANGING... DONE.



9-22 © 1994 United Feature Syndicate, Inc.

NATURALLY, I
WON'T BE
SHARING ANY
OF THESE
THOUGHTS
WITH
ENGINEERING.

I BUDGETED
FOR SOME
GOONS TO
BEAT IT
OUT OF YOU.



Emphasis on Realism

- Do not prepare an estimate to accommodate what someone wants to hear.
- Estimate what you think the program is actually going to cost.
- Program Managers need realistic cost estimates to support the financial decision-making process.

Summary - Step 2

Estimating Methodology

- Specify & Implement an Estimating Methodology
- Know strengths & weaknesses for each
- Develop estimates more than one way
- Use sound logic & supporting methods
- Collect data & evaluate
- Assess risk including cost sensitivity studies and range estimates

Step 3: Calculate the Cost Estimate

- Calculate in Base Year dollars.
- Calculate confidence checks, the cost of alternatives, and any cost sensitivities.

Step 4: Time Phase the Cost Estimate

- Time Phasing
- Engineering, Manufacturing & Development (EMD)
- Procurement
- Operations & Support (O&S)/Sustainment
- Consistency with Acquisition Strategy

Time Phasing

- Take the total cost in Base Year dollars from Step 3 and decide how much of that to ask Congress for in each Fiscal Year.
- Allocating or distributing Base Year dollars to various Fiscal Years is referred to as time phasing the estimate.
- The time phasing must be consistent with the program schedule, budget regulations & the Program Acquisition Strategy.

Engineering, Manufacturing & Development (EMD)

In the EMD appropriation, a Program is incrementally funded. Each Fiscal Year's Total Obligation Authority (TOA) - the amount you ask Congress for - includes only the costs you expect to incur that Fiscal Year.

Procurement

- Procurement efforts are full funded.
- Each Fiscal Year's TOA includes the total Prime Mission Equipment cost of all units authorized for production in that Fiscal Year plus all the associated acquisition support costs (i.e. SE/PM, STE, Training, etc).

Operations & Support (O&S)

- The O&S appropriation is one year money. It is funded in the year that the associated work will be done.

Consistency With Acquisition Strategy

- The Program time phasing must be consistent with the contract and acquisition strategy.
- Take time to find out exactly how the contract is set up to ensure consistency.

Step 5: Inflate to Then Year Dollars

- Translate your time phased Base Year (BY) dollars into what the Program will actually cost in the Fiscal Years you are requesting the money.

Step 6: Document the Cost Estimate

- Document AS YOU GO rather than wait until the end.
- Include
 - Program definition
 - Estimating methodologies and all supporting rationale
 - Risk information
 - Time phasing methodology

High Quality Cost- Estimate Documentation

- EXPLICIT, CLEAR and CONCISE.
 - Short and to the point without missing anything important.
- A logically developed estimate should be very straightforward.

Step 7: Complete Final Reviews

- Schedule Periodic Reviews
 - Complete your final reviews with PMs, FMC Chiefs and functional experts
 - Reviews are also accomplished AS YOU GO

Complete Final Reviews

An important separate meeting you should schedule is with the functional specialists **BEFORE** you present any numbers.

- Show them their inputs - such as 50,000 lines of code (no dollar amounts)
- Relate to them their ground rules and assumptions - 50% of the code is already written
- Explain: the technical information provided is what will be used to derive the cost estimate

Summary of the Estimate Process

- 1 - Define and Plan
- 2 - Specify Estimating Methodology
- 3 - Calculate
 - Including What-ifs and Alternatives
- 4 - Time Phase in Base Year Dollars
- 5 - Inflate to Then Year Dollars
- 6 - Wrap Up Documentation
- 7 - Complete Final Reviews